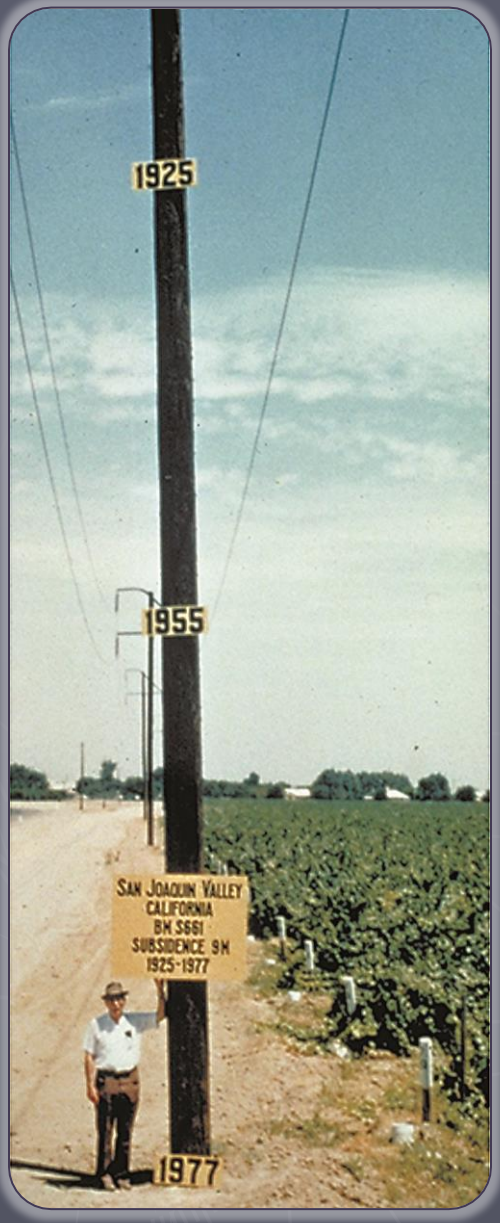

Land Subsidence along the Delta-Mendota Canal in the Northern Part of the San Joaquin Valley, California

Michelle Sneed
California Water Science Center
U.S. Geological Survey
March 26, 2014

http://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html

Summary

- 1,200 mi^2 area subsided ½-11 inches/year during 2008-10; surveys indicate these rates have continued through 2013
- Adversely affecting water conveyances and other infrastructure
  - Delta-Mendota Canal, California Aqueduct, Eastside Bypass, San Joaquin River, local canals
- Subsidence is largely permanent
- Subsidence occurred when groundwater levels declined to historically low levels as a result of pumping
- Recent subsidence has shifted about 25 mi northeast from historical (1926-70) maximum
- Long-term monitoring of water levels and subsidence is needed to detect and track groundwater conditions for decision support

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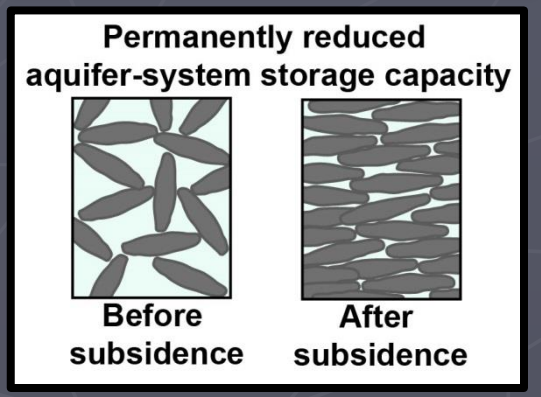
Subsidence Damages Natural Resources and Infrastructure


2 year old well (drilled 2010). Land surface shows 2 feet of subsidence (well location shown on map). Photo courtesy Sarge Green, California Water Institute.

- Flood Protection and Infrastructure
  - Damage to water conveyance systems and other infrastructure
    - Reduced conveyance capacity and freeboard, panel damage; water surface and liner misalignment; erosion/deposition in unlined channels
    - Roads, rails, bridges, pipelines, wells, etc.
- Natural resources
  - Reduces aquifer-system storage capacity
  - Impacts to wetland, riparian, and aquatic ecosystems
  - Restricted land uses



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Impact on Infrastructure

Canal photos courtesy of Chris White, Central California Irrigation District

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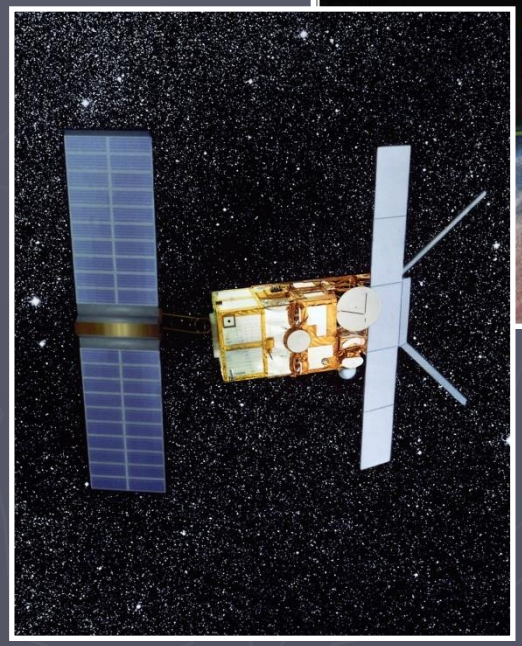
Measuring Subsidence

Bench Mark

Spirit Leveling

GPS

InSAR



Extensometer*

*measures part of land subsidence

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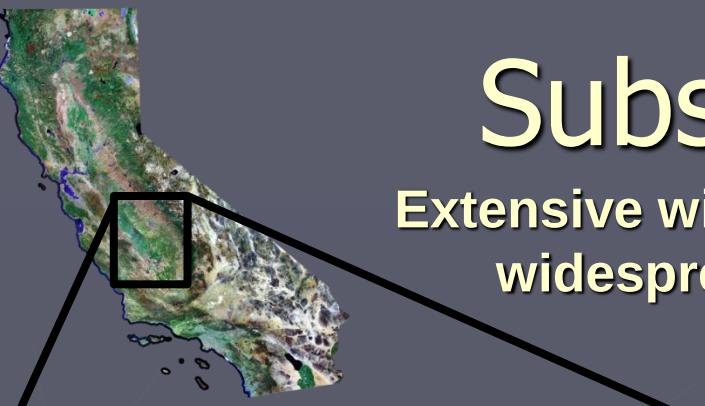
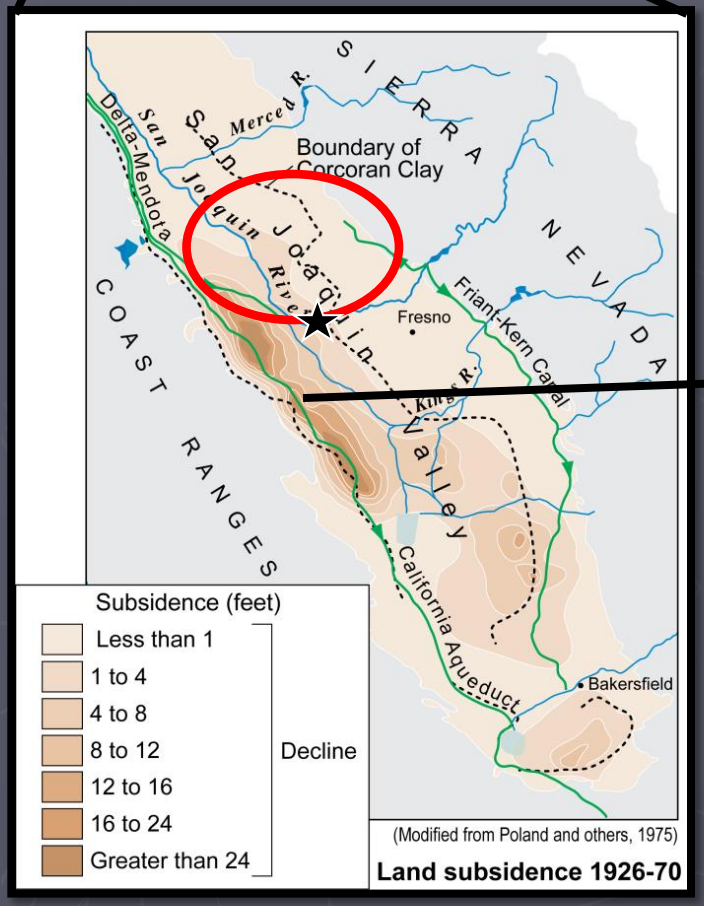
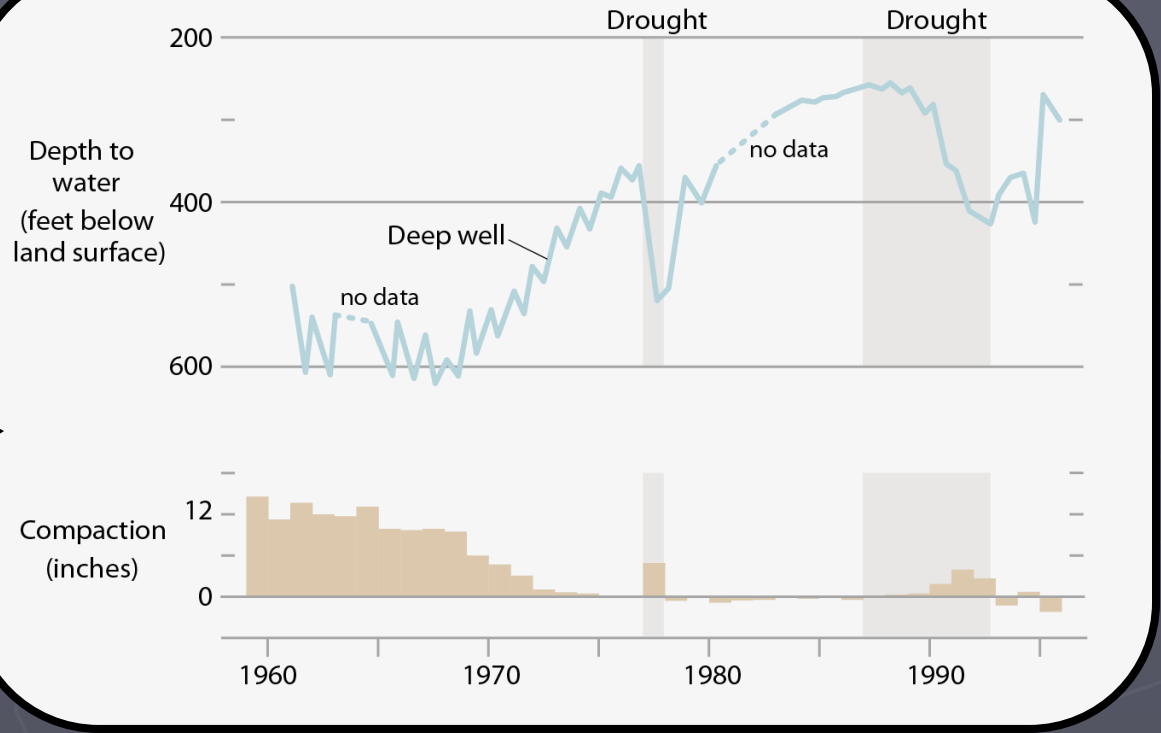
Subsidence History

Extensive withdrawal of groundwater caused widespread subsidence (1920s-1970)







Surface-water deliveries caused widespread recovery and slowing or cessation of subsidence, except when deliveries were curtailed and groundwater pumping increased to meet demand

Galloway and others, 1999; USGS Circular 1182

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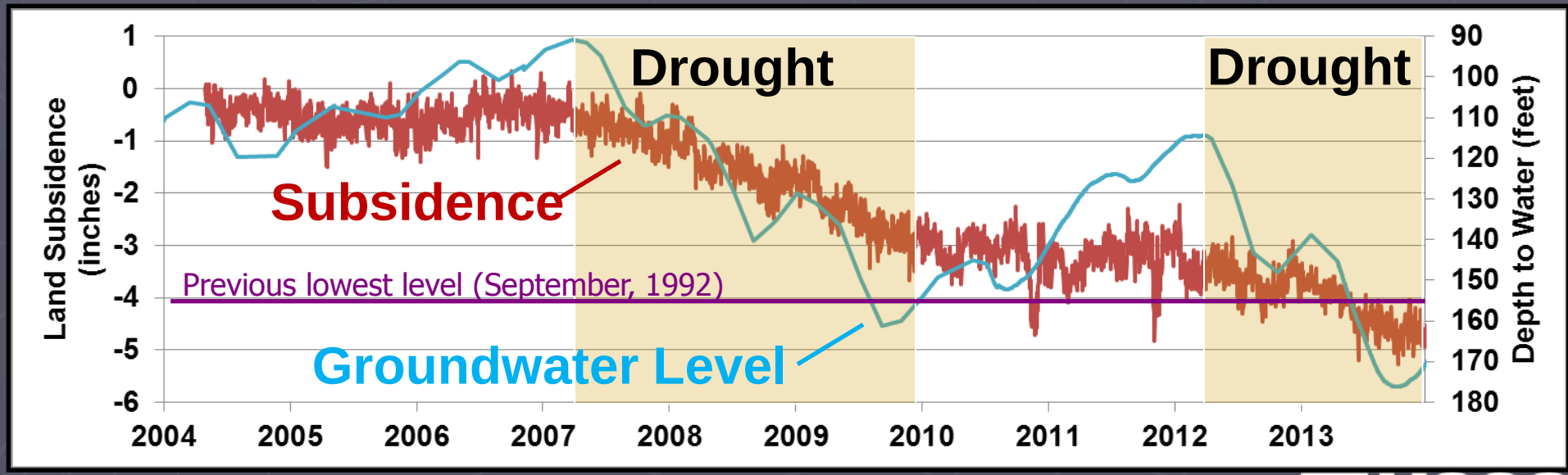
Recent Subsidence

- Renewed subsidence concern during 2007-09 drought, and now, the current drought
  - Reduced surface water importation
  - More reliance on the groundwater resources
  - As it turns out…this is not just a problem during droughts for some areas with little or no surface-water access



P304 data from UNAVCO; 2004-10 water-level data from Luhdorff and Scalmanini Consulting Engineers

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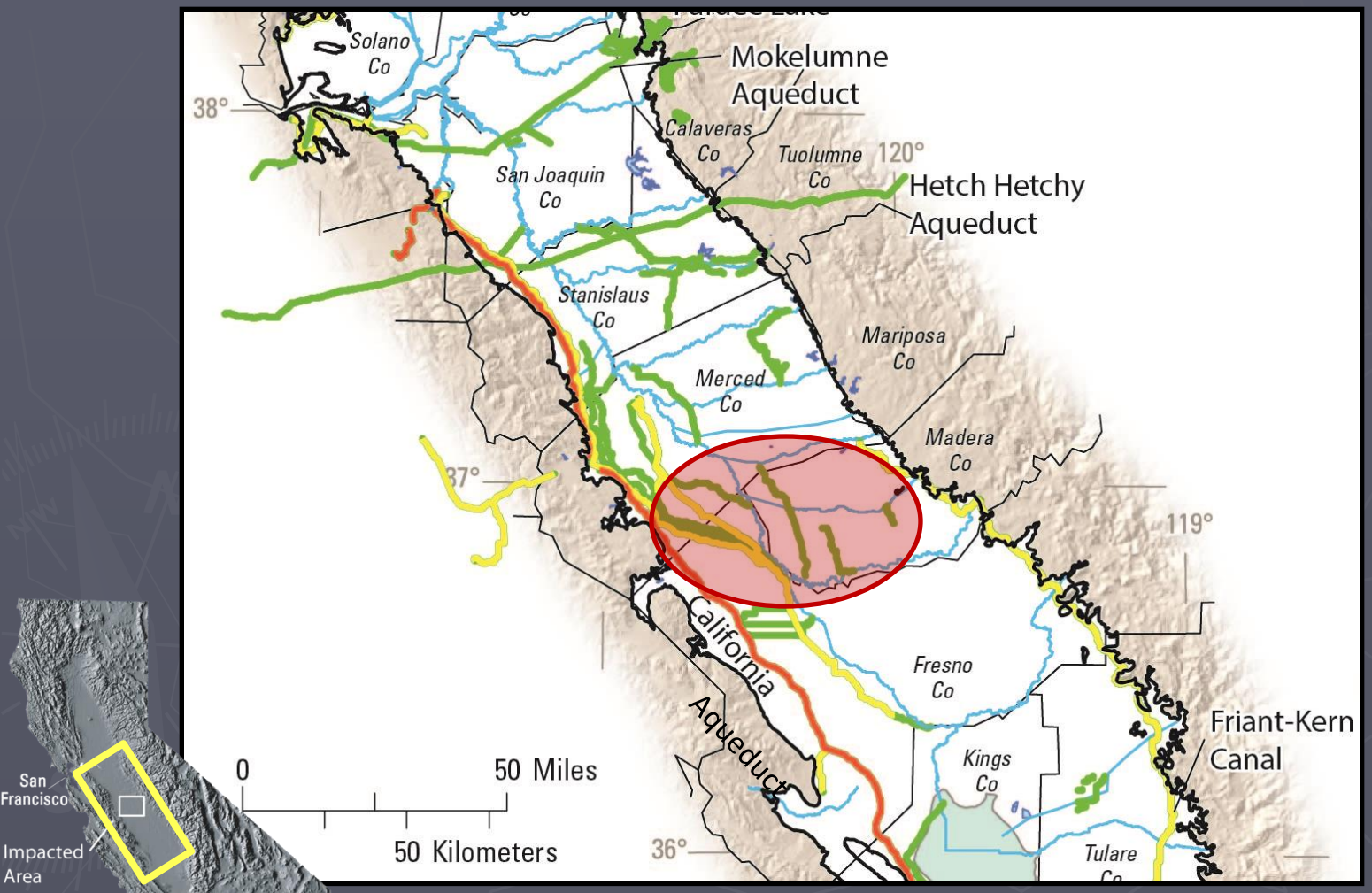
Federal, State, and Local Water Infrastructure in the Impacted Area



Modified from Faunt, 2009

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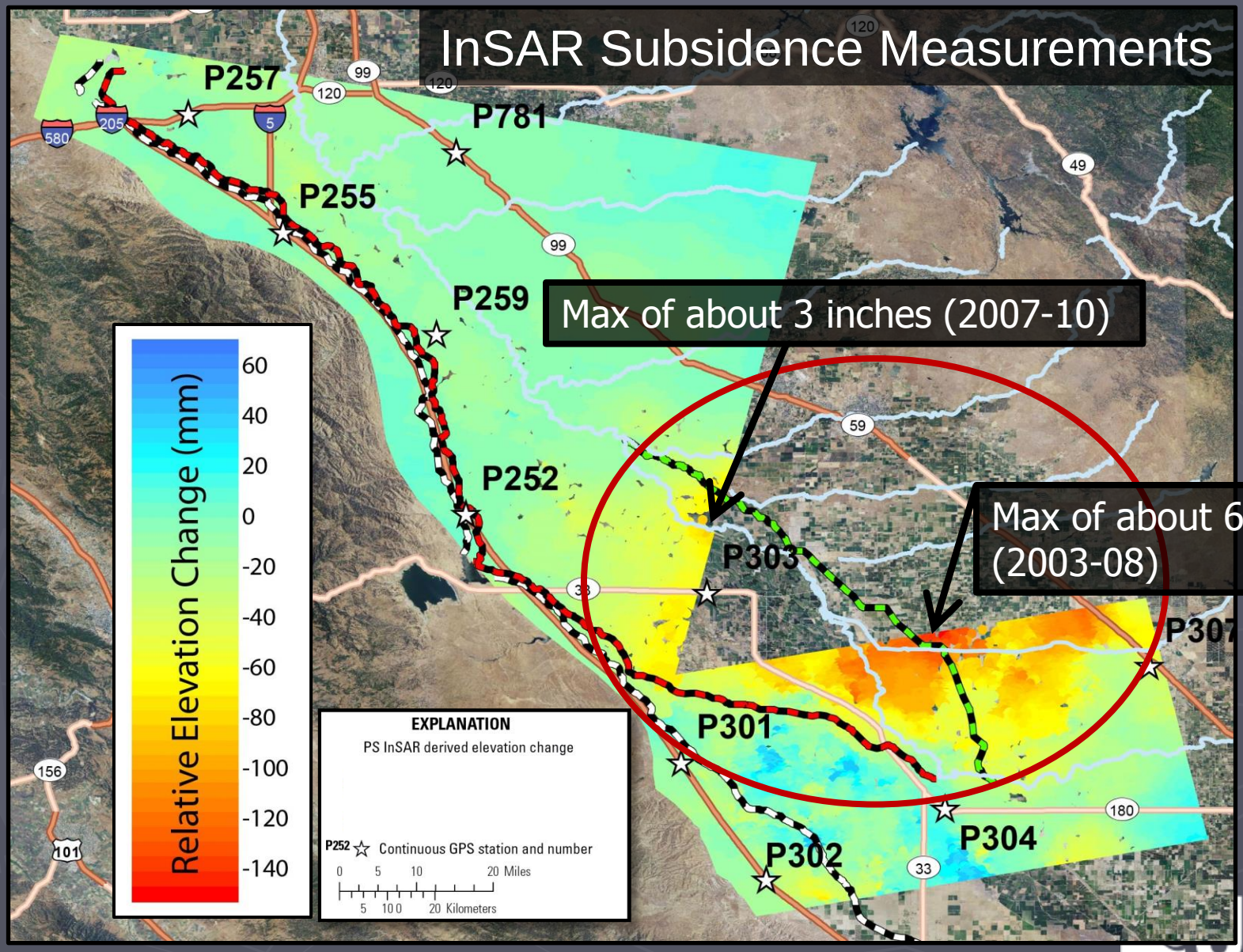
Detected Edges of Subsiding Area



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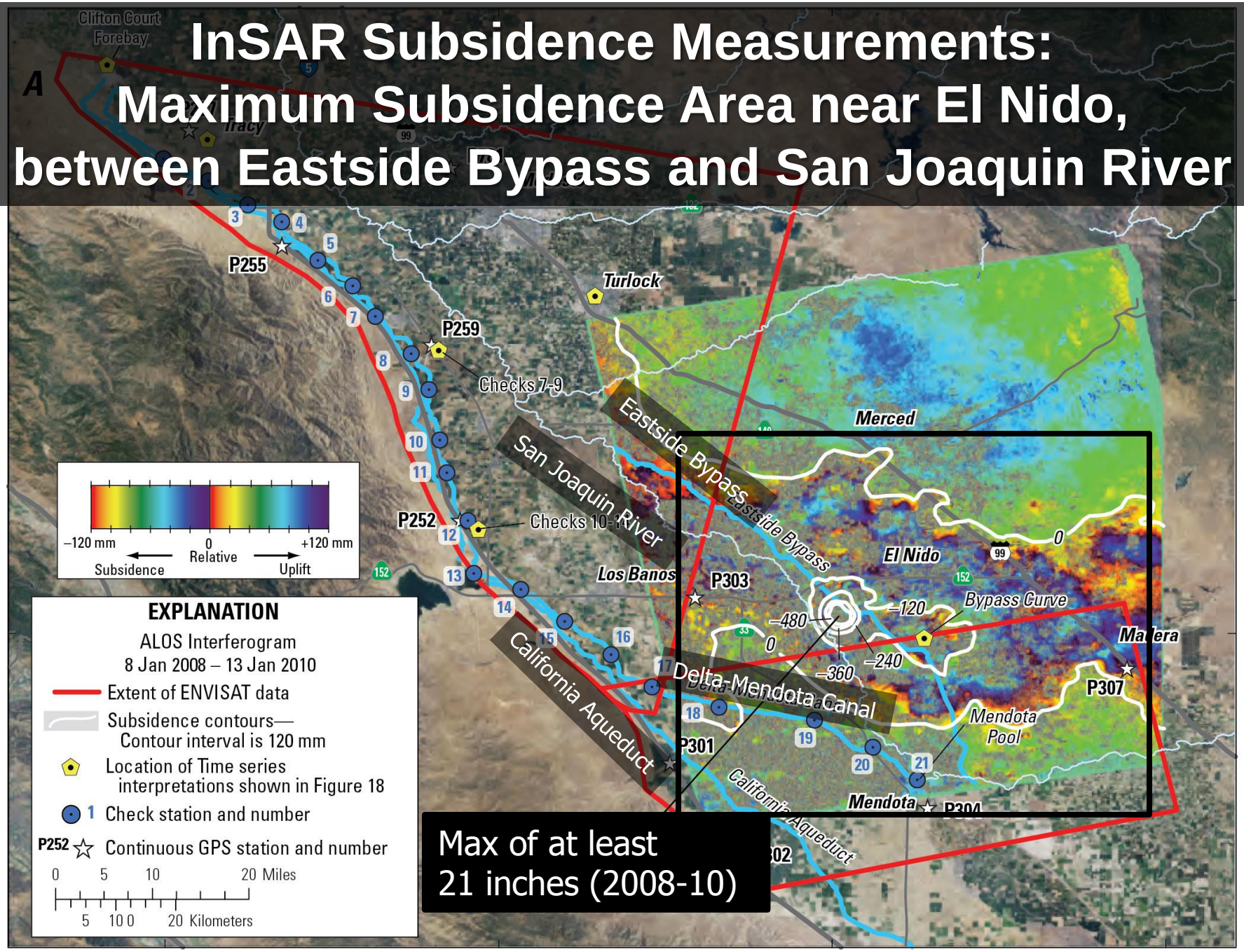
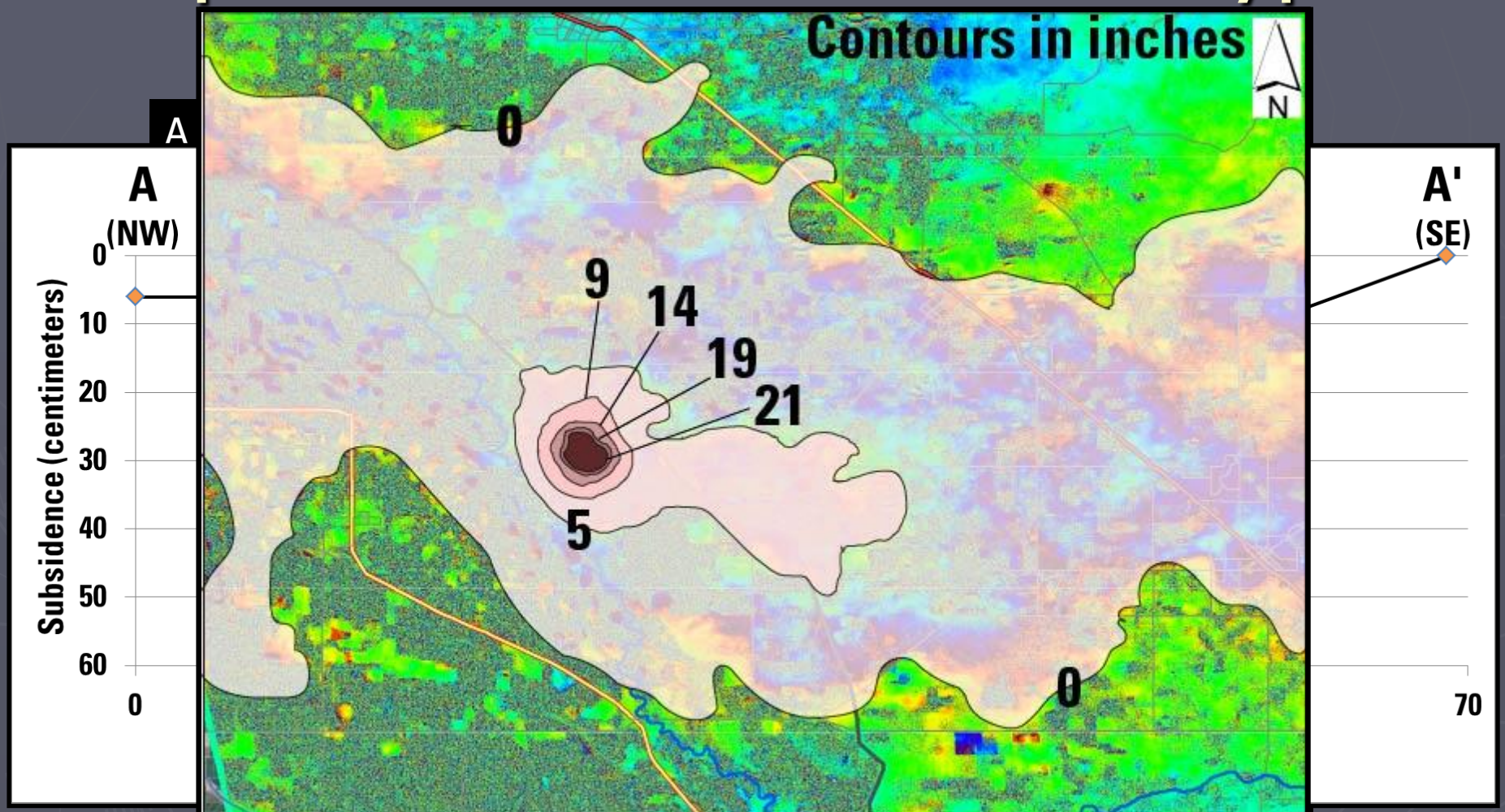
InSAR Subsidence Measurements: Maximum Subsidence Area near El Nido, between Eastside Bypass and San Joaquin River



Highest Impact: Adjacent to San Joaquin River and Eastside Bypass



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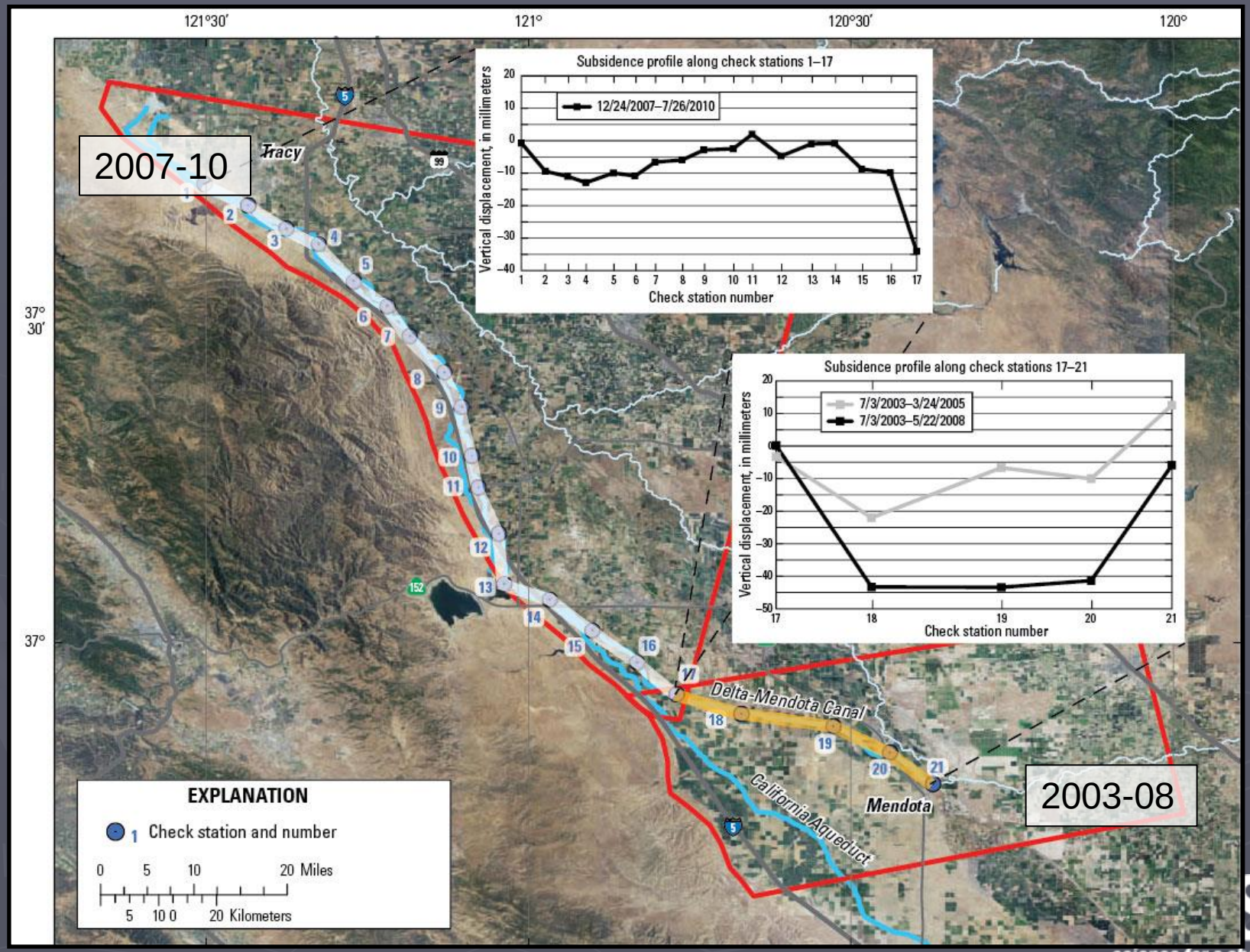
Subsidence along the DMC



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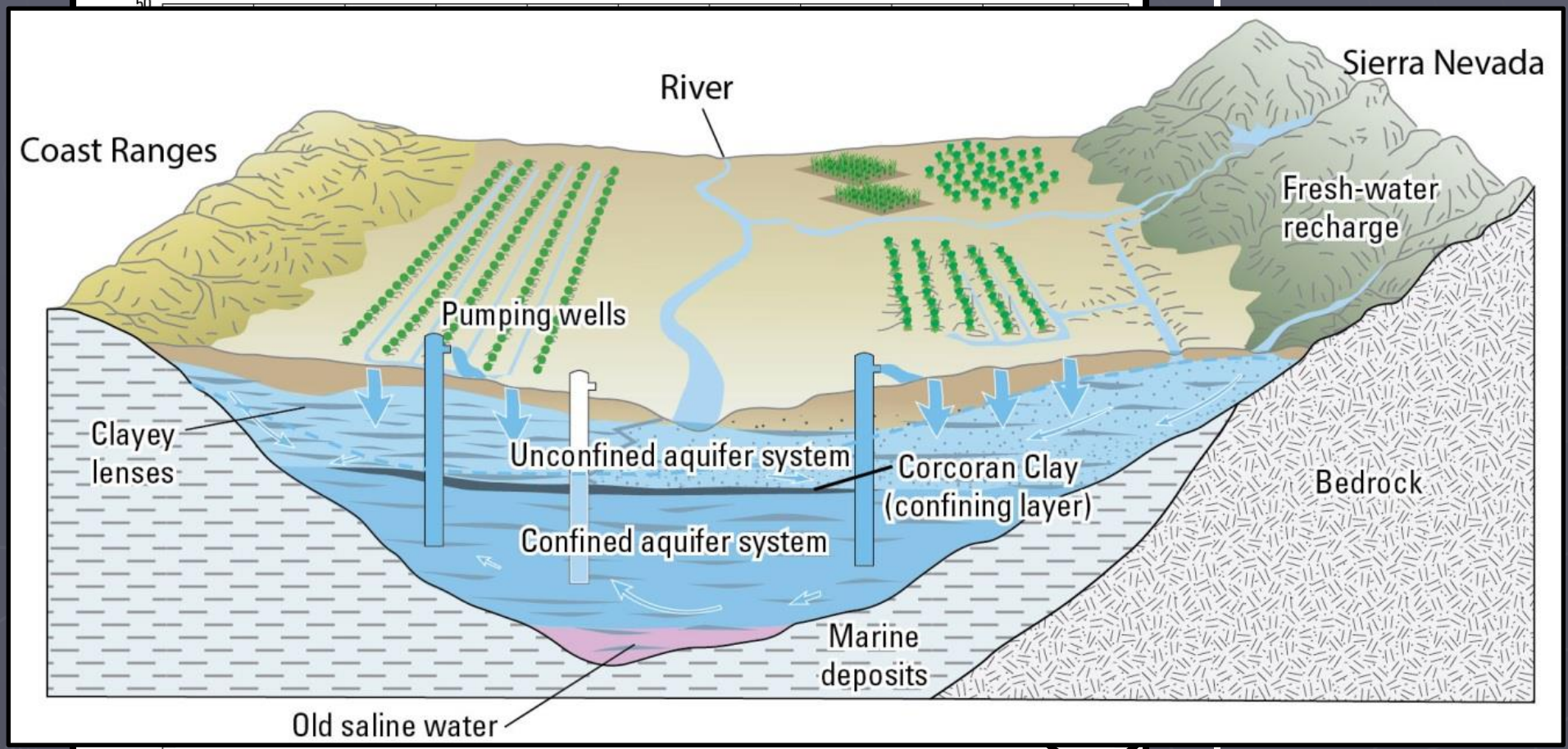
Water levels in the Shallow and Deep Systems Declined 2007-10



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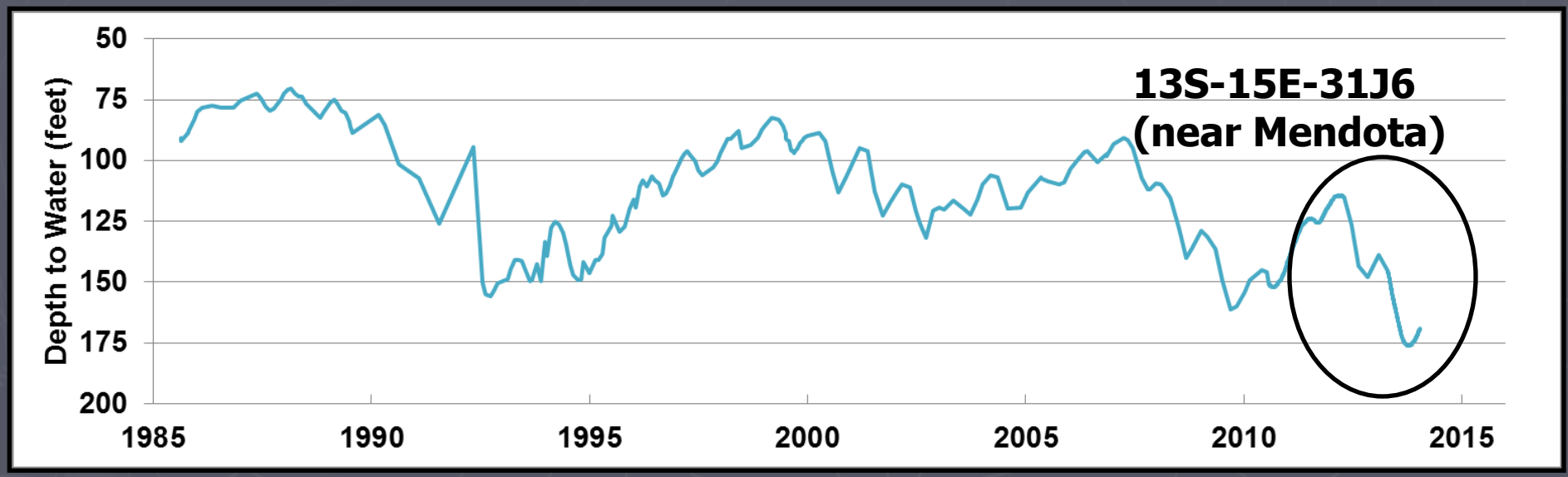
Groundwater Levels Continue to Decline



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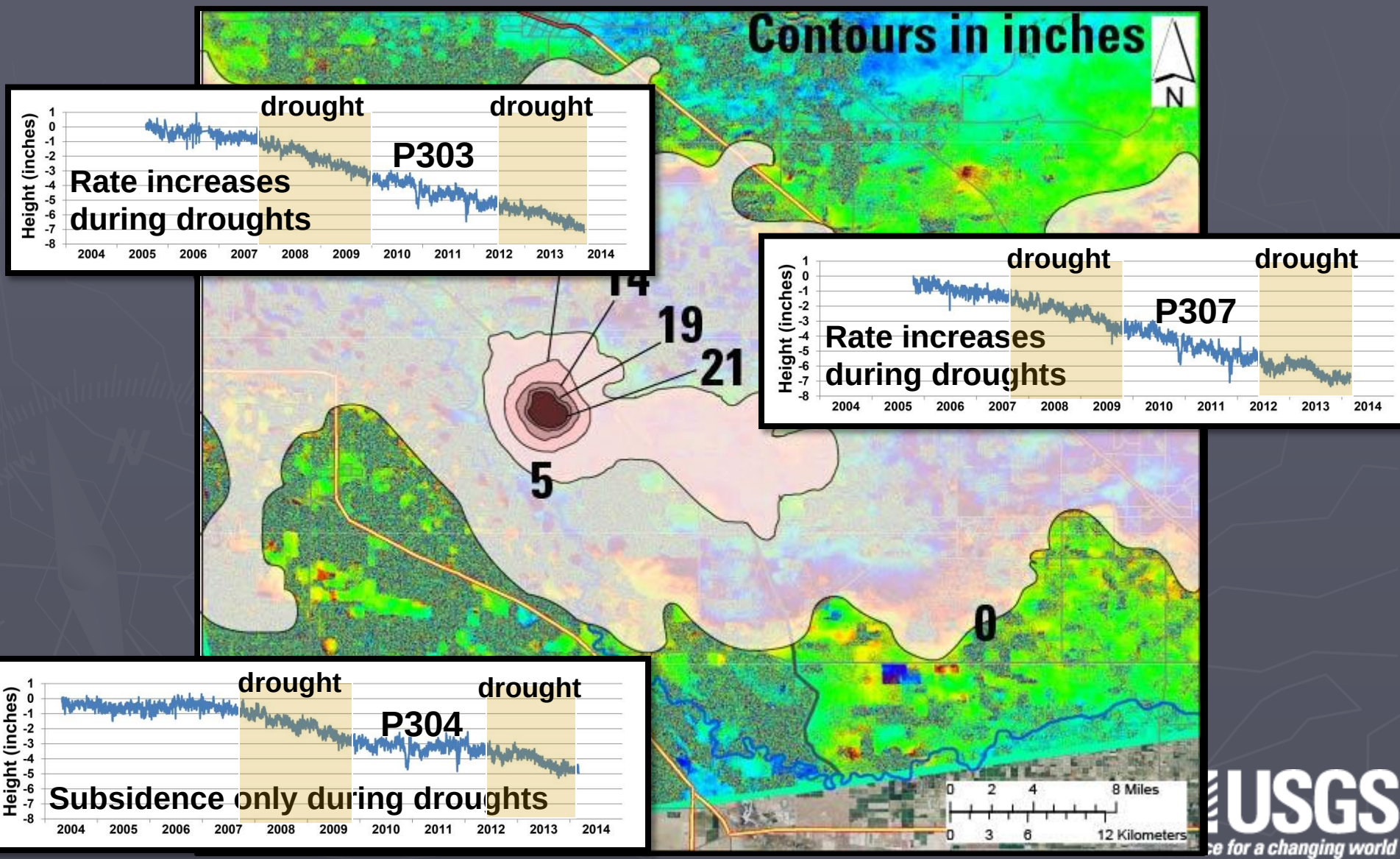
GPS Subsidence Measurements



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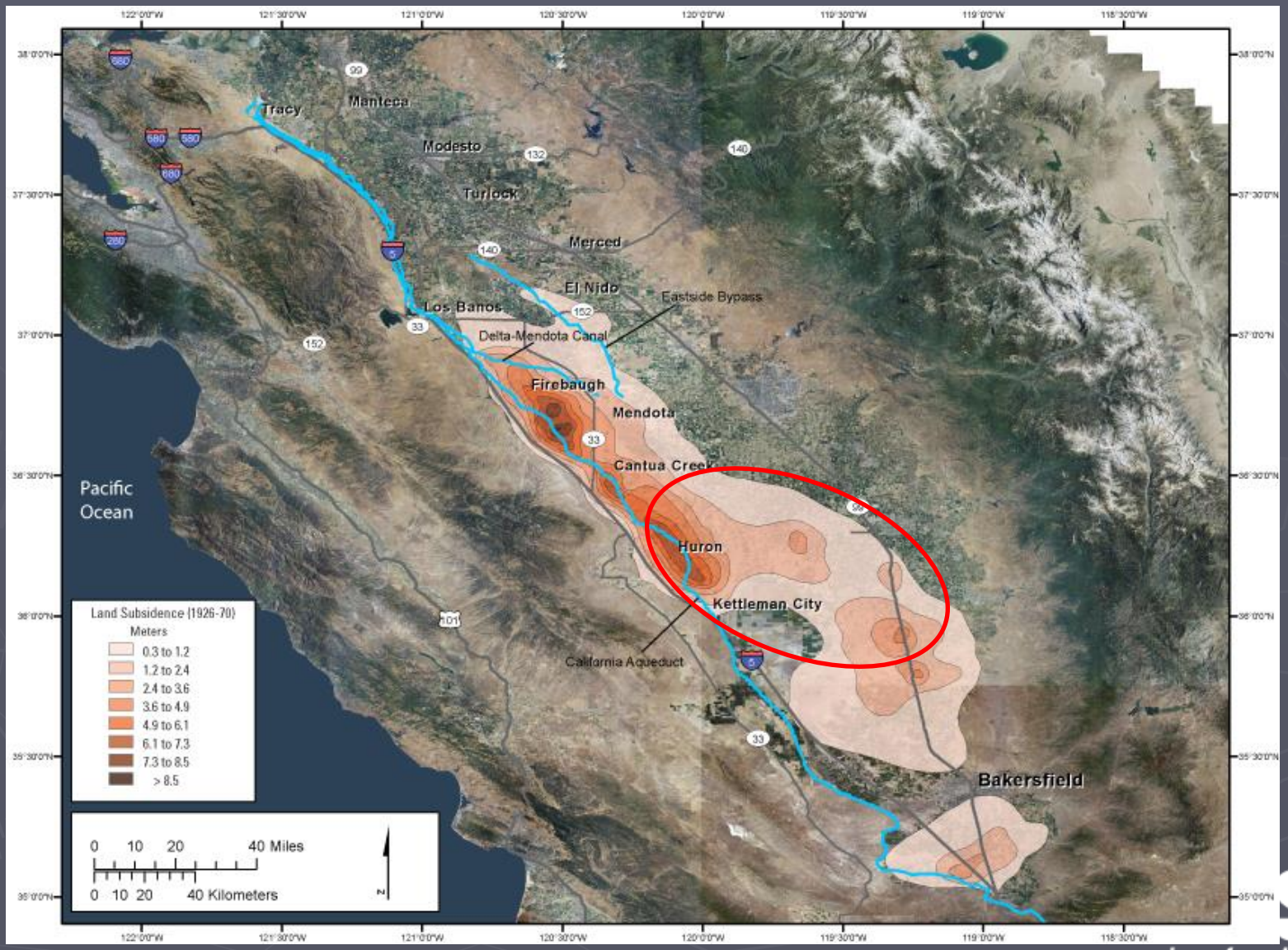
Historical Subsidence



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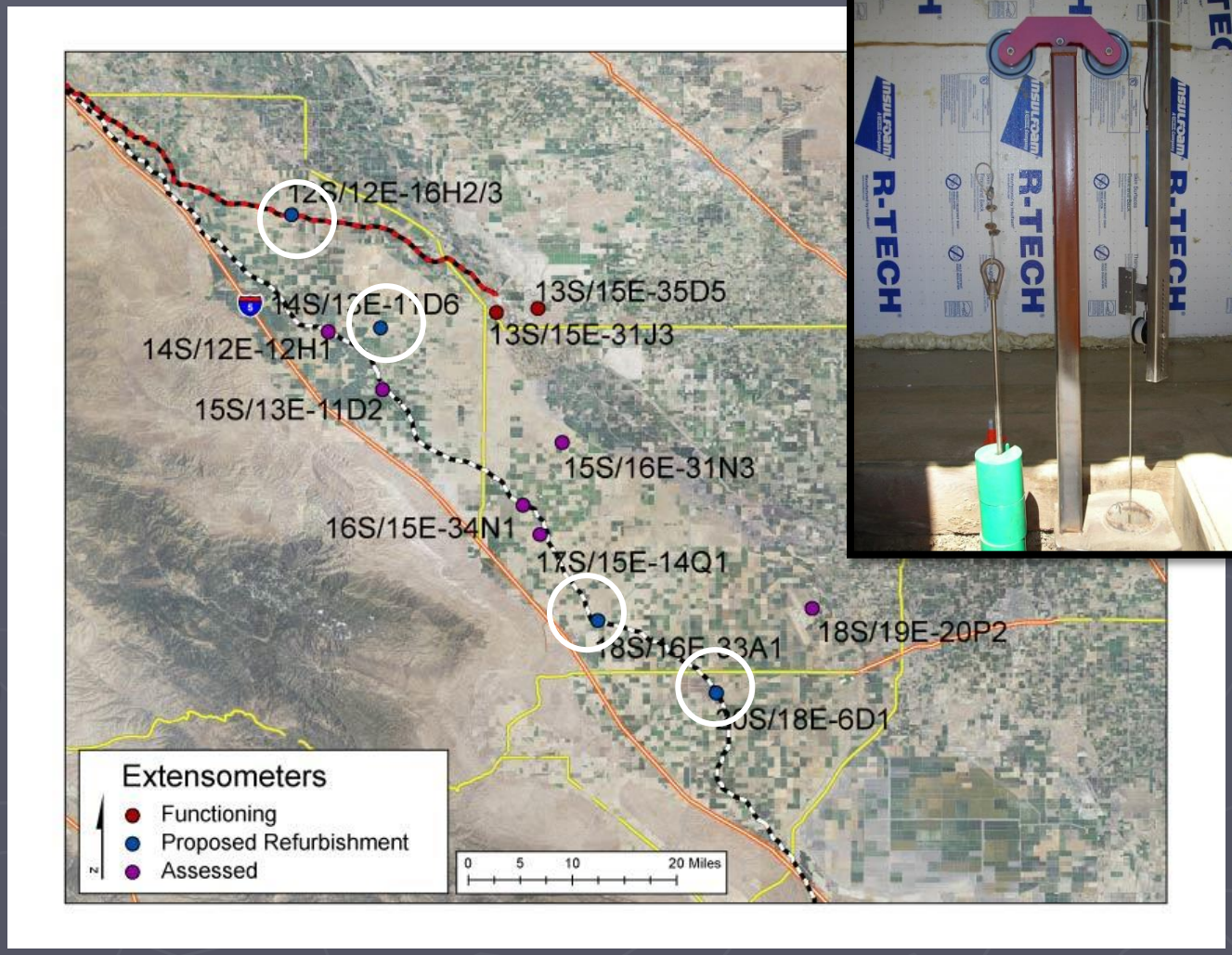
Current Activity: Extensometers

- Oro Loma (16H2)
- Panoche (11D6)
- DWR Yard (33A1)
- Rasta (6D1)



Hourly measurements of aquifer-system compaction and groundwater levels

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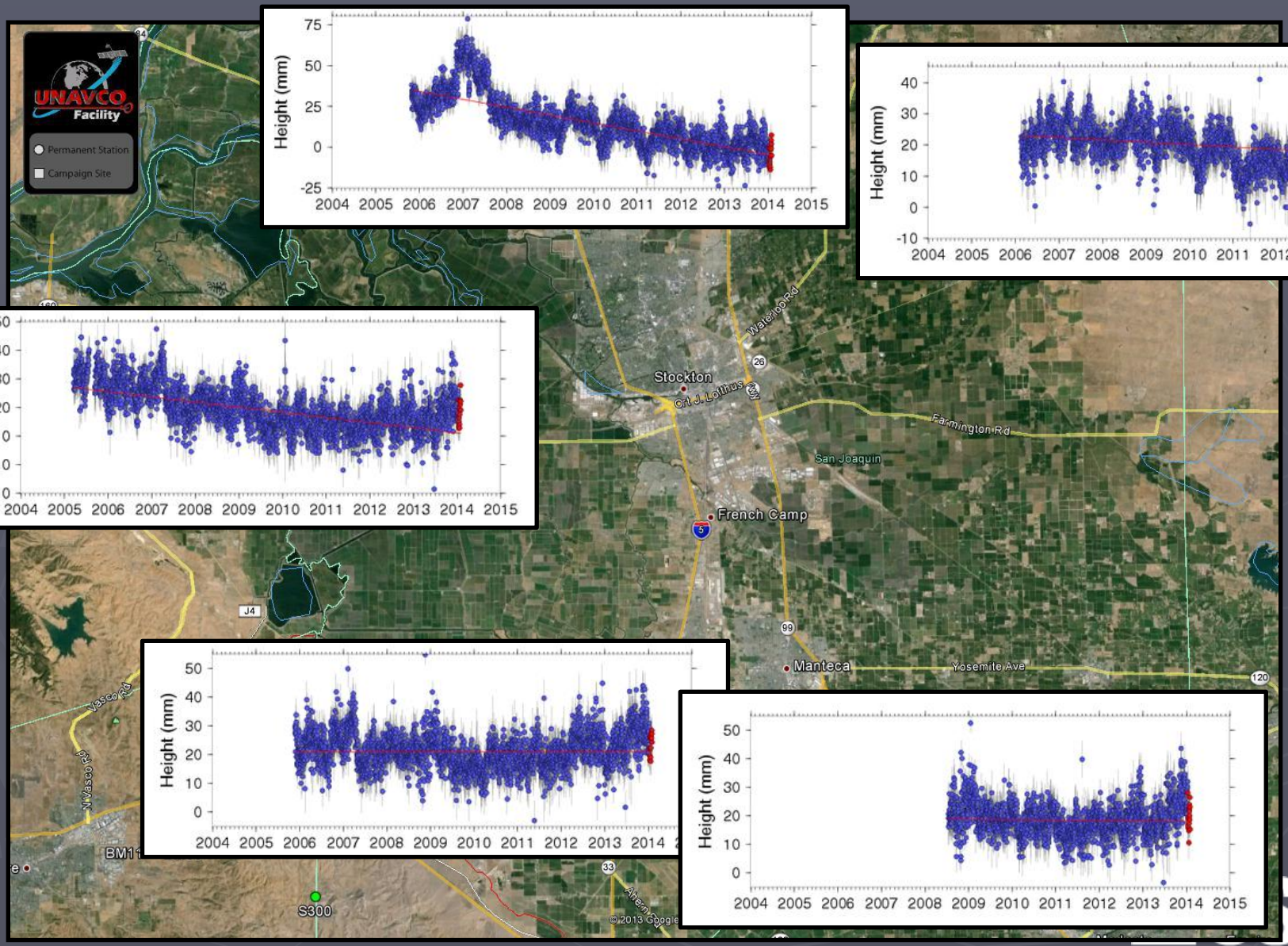
Subsidence near Stockton



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What Can Be Done About It?

- Focus on maintaining groundwater levels above historical low levels
  - Reduction of groundwater withdrawal
    - Decreasing groundwater demand
    - Limiting/redistributing groundwater use
    - Increasing supplemental water supply
  - Enhanced groundwater recharge
    - Artificial recharge: direct well injection or surface infiltration
    - Natural recharge: source protection
- Long-term monitoring of water levels and subsidence is needed to detect and track groundwater conditions for decision support

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Thanks!

http://ca.water.usgs.gov/projects/central-valley/delta-mendota-canal.html

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